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ABSTRACT

A mapping strategy for improving critical thinking about expository text was employed in a study designed to help six high school students with difficulties in reading comprehension. Subjects were four sophomores in a remedial reading program and two juniors in a special education program for the mildly retarded. Subjects read passages from an unfamiliar textbook on U. S. history. The teacher first modeled the critical thinking strategy, then led the student in completing the map, and finally allowed the student to complete the map independently. The components of the critical thinking map were the main idea of the passage, major points that support the main idea, other viewpoints, reader's conclusion, and relevance to a contemporary situation. Findings indicated that all subjects improved substantially in daily comprehension of lessons, though remedial reading students better maintained their improvement over time. Results also showed that all subjects improved their comprehension of passages from a different social studies text, indicating an ability to generalize to similar content. In addition, four students showed improved generalization to reading in a different content area. Findings also indicated that all subjects improved on a standardized test of reading vocabulary and that five of the six subjects improved on a test of reading comprehension. Finally, results showed that the ability to generalize to nonverbal thinking tasks improved for all but one subject and that the verbal thinking of all subjects improved. (Twenty-eight references are included.) (Author/JD)

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CENTER FOR THE STUDY OF READING

Technical Report No. 402

A CRITICAL THINKING MAP TO IMPROVE CONTENT AREA COMPREHENSION OF POOR READERS

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Abstract

A mapping strategy for thinking critically about expository text was used with six high school students who had difficulties in reading comprehension: Four were sophomores in a remedial reading program, and two were juniors in a special education program for the mildly retarded. Subjects read passages from an unfamiliar textbook on U. S. government history. The format was model-lead-test; i.e., the teacher first modeled the strategy, then led the student in completing the map, and finally allowed the student to complete the map independently. The components of the critical thinking map were: main idea of the passage, major points that support the main idea, other viewpoints, reader's conclusion, and relevance to a contemporary situation. All subjects improved substantially in daily comprehension of lessons. Remedial reading students showed better maintained improvement over time. All subjects improved comprehension of passages from a different social studies text indicating ability to generalize to similar content. Four students also showed improved generalization to reading of a different content area. All subjects improved in a standardized test of reading vocabulary and five of the six improved on a test of reading comprehension. All but one subject demonstrated improved generalization to nonverbal thinking tasks and all improved for verbal thinking.

A Critical Thinking Map to Improve Content Area Comprehension of Poor Readers

Reading researchers and educators have been cautioned not to place the cart before the horse when developing techniques for improving reading comprehension of content areas (Vacca & Vacca, 1983). This reversed order has resulted in the development of teaching methodologies *prior* to developing theories about how the process of how efficient reading occurs in good readers. It is likely that techniques which are exemplifications of theories are those that prove to be most effective, as well as being those that contribute most to our own understanding of how humans process written information.

Reading and Thinking

An example of the preferred order, theory preceding practice, can be seen in recent advances made in reading comprehension research during the past 15 years. Particularly germane are two theories which have examined the relationship between reading and thinking: schema theory and metacognitive theory.

Schema theory. Schema theorists have made a major contribution to our understanding of how thinking impacts upon the reading process (i.e., Anderson, 1977-78; Anderson, Spiro, & Anderson, 1978; Rumelhart, 1981; Spiro, Bruce, & Brewer, 1980). According to this theory, the correspondence between a reader's underlying knowledge structures (schemata) and textual material determines the extent of comprehension. The critical thinking map used in this study contains various subcomponents related to three areas identified by Spiro (1980) as being pertinent to instruction which builds knowledge structures. They include (a) developing an awareness of the nature and limitations of existing schemata, (b) learning to use schemata efficiently and effectively within these limitations, and (c) recognizing the relationship between existing schemata and the reading material.

Metacognitive theory. Some of the most noteworthy advances in understanding comprehension have been made by theoreticians interested in metacognition. Flavell (1981) describes metacognition as a knowledge which regulates any aspect of any cognitive endeavor. Baker and Brown (1984) define metacognition as reference to one's understanding of any cognitive process, using skills which involve planning, checking, and evaluating as one reads. It is the process that allows us to think about what we are reading as we read. Collins and Smith (1982) discussed two different sets of processing skills that have emerged from research on metacognition. The first are *comprehension monitoring* skills, which involve the reader's monitoring of ongoing processing for comprehension failures, and taking remedial action when failure occurs. Development of these skills in poor readers is the focus of the work of Brown and Palincsar (i.e., Brown & Palincsar, in press; Palincsar & Brown, 1984).

In contrast, the second type of skills have to do with *hypothesis formation and evaluation*. These involve using clues in the text to generate, evaluate, and revise hypotheses about current and future events in the text. The latter set of skills are more characteristic of the type of instruction used in this study. A distinction is that instead of relying solely on textual clues, a critical thinking map (see Figure 1) is used to provide the reader with a set of stimuli to use for generation, evaluation, and revision of hypotheses.

Baker and Brown (1984, p. 354) have identified several metacognitive skills involved in reading that are related to components of this critical thinking map. These skills are:

1) clarify the purposes (understanding both explicit and implicit task demands).

2) identify the important aspects of a message.

3) focus attention on the major content rather than trivia.

4) monitor ongoing activities to determine whether comprehension is occurring.

5) engage in self-questioning to determine whether goals are being achieved.

6) take corrective action when failures in comprehension are detected.

The Critical Thinking Map

The critical thinking map used in this study meets these standards in several ways (see Figure 1). The map contains five components which the reader must complete either during or after reading a passage in a social studies text. They include: (a) the important events, points, or steps which lead to the main idea/lesson, (b) the main idea or lesson itself, (c) the other viewpoints and opinions of the reader, (d) the reader's conclusion upon reading the passage, and (e) any relevancy the reader sees between what was read in the passage and contemporary situations. Following are more explicit explanations of the five components.

[Insert Figure 1 about here.]

Important events. These are the important happenings (events, points, or steps) which lead to the main intent or main idea of the lesson presented in the text. They are stated explicitly in the text and may be presented in several ways. One example is when important points are presented in a compare/contrast fashion. In this case the map user would divide the map component in half, listing the points for each of the two sides of the issue. Another example is to present the points in a pro/con display, listing the positive and negative attributes of the issue. A third map use example is to list cause and/or temporal points, indicating the influence of each point upon successive points by using connecting, causal arrows to identify the important aspects of a message. The second metacognitive skill listed above by Brown is met by this component.

Main idea/lesson. This is the most important message conveyed by the author and can be textually explicit, textually implicit, or scriptally implicit (see Pearson & Johnson, 1978), or any combination of the three. In some cases there may be more than one main idea or lesson presented in the passage. These may go well beyond what is in the text itself, reflecting the overall attitude of the author toward the information presented in the text. Brown's suggested first and third metacognitive skills, clarifying purpose and focusing attention on major content, speak to this component of the critical thinking map.

Other viewpoints/opinions. These responses reflect the reader's own viewpoints and opinions about what has been read. This is the background information and world knowledge the reader already possesses prior to reading the passage. Aside from asking readers about their opinions of what they read, this information could be elicited by asking which other information or opinions may not have been stated by the author, by asking how else the reader could think about this information, or by asking readers what else they know about the lesson topic that might affect their overall understanding or conclusions.

This component is related to the fourth skill in Brown's list, monitoring ongoing activities to determine whether comprehension is occurring, by thinking about what one knows as one reads. Baker and Brown (1984) refer to this as one of several types of comprehension failure and one defined almost 20 years ago. The failure occurs because the reader interprets material in a manner desired by the author, rather than considering an alternative interpretation, and is thus deluded to a certain degree (Eller, 1967).

Metacognitive skills five and six, as listed by Brown, are utilized by the reader as all of the above map components are filled in. These involve checking with oneself to determine whether the tasks required by the components are being met, and making changes and corrections when failures to comprehend are detected.

Readers' conclusions. The content of this response comes from the integration of what readers have read with what they already know. Based upon this integration, readers must decide if the author's conclusions are valid or invalid. Users of the critical thinking map express reasons to support their choice by stating final conclusions about the passage, based on the combined knowledge from all of the preceding map components.

Relevance to today. The task here is to require the reader to engage in a final form of integrative thought, making comparisons between the historical lesson they read about and thinking about what modern people can learn from past events. The intent is to assist the reader in understanding how we can live better today by examining how people lived in the past. The reader is asked to draw these comparisons so that as a people we might make better choices for living by our understanding of past events. The reader's ability to do this requires retrieval of the previously collected information, as well as of previously-stored world and experiential information. These two classes of remembered events must be integrated resulting in an original and synthesized solution to the question of relevancy.

Finally, the critical thinking map helps to correct for another type of comprehension failure, also discussed by Baker and Brown (1984). This failure occurs when readers have the appropriate schemata, but the author has not provided enough clues to suggest use of the relevant schemata. In this case the author is at fault for not conveying ideas clearly enough, yet the map provides the structure for aiding readers in a search for those clues.

In summary, the critical thinking map stimulates a kind of hypothesis formation skill that allows the reader to make interpretations of the text as opposed to making predictions about what will happen next. As recommended by Collins and Smith (1982) the focus is on the process of comprehension, rather than on the product. The method employed in this study begins with teacher modeling of the desired process. This modeling phase, as advocated by Collins, et al., is essentially a slow motion picture of how comprehension takes place in a sophisticated reader. Then using a model-lead-test paradigm (Englemann & Carnine, 1982; Idol, in press; Idol & Croll, in press; Idol-Maestas, 1985), the teacher gradually shifts the responsibility of hypothesis formation to the shoulders of the reader. This shift is accomplished by following teacher modeling with a teacher-assistance phase (*lead*), and then finally requiring the reader to perform independently (*test*).

It only stands to reason that these theories about reading and thinking should form the foundation for development of methods to prepare students to read content area materials. But, the most important test of relevancy is whether or not these techniques can be used to alter the comprehension behavior of students who appear to understand little of what they read. This effectiveness can be demonstrated if certain conditions prevail: (a) the reader is able to employ the strategy, (b) the immediate reading comprehension of the reader is improved, (c) the reader demonstrates an ever-increasing ability to use a strategy without teacher assistance, (d) the reader continues to read with improved understanding after the artificiality of the instructional technique has been removed, and (e) some generalizability of the improvement can be found in reading content not previously used for instruction, in content relatively different from that used for instruction, and in other applications of the thinking process itself, as seen in some standardized tests of nonverbal and verbal thinking abilities.

Method

Subjects

The subjects were six high school students whose teachers identified them as having difficulty with reading comprehension, yet who were viewed as having adequate word recognition skills. For puposes of this study, this will be used as the definition for poor readers. Refer to Table 1 for a summarization of the entry levels for both vocabulary and comprehension as measured by the Stanford Diagnostic Reading Test (SDRT). These test data were in the students' permanent records, had been administered at the end of the previous school year, and were used by the teachers as an aid in selecting suitable students for the study; teacher judgment was the final selective factor. Table 1 also contains a measure of how poorly the students were comprehending prior to the study. This is a discrepancy score reflecting the years-months between the students' grade level prior to the study and the reading comprehension score on the SDRT. Four subjects were only adequately comprehending materials three or more years below grade level. The remaining two students showed differences of 2.8 and 1.2 years below grade level.

Two students were sophomores and four were juniors; four were enrolled in a remedial reading program and two in a self-contained special education program for educable mentally handicapped students. All six students attended the same high school in a medium-sized, midwestern city. The remedial reading students were two white females aged 16, one black male aged 16, and one white male aged 15. All four of these students were of average intelligence. The special education students were one black female, and one white female, both aged 16. These students had intelligence scores of 59 and 72 (respectively) on the Weschler Intelligence Scale for Children-Revised. In total, there were four females and two males, four white and two black students.

[Insert Table 1 about here.]

Teachers

The teachers were two white, female, graduate level research assistants, both of whom were experienced classroom teachers.

Procedures

Research design. The experimental design was an AB/maintenance, single-subject design with multiple baseline across students. The intervention (B) phase had multiple phases embedded within, as a means of shaping an independent level of response. The students were randomly assigned to baselines ranging in length from four to ten days and stratified by assignment to either remedial reading or special education programs. In this design, subjects serve as their own control via the extended baseline across subjects where each subject's baseline performance is expected to be depressed until initiation of the intervention (Baer, Wolf, & Risley, 1968; Hersen & Barlow, 1977; Kazdin, 1982). In this study, the second baseline serves as a maintenance phase, during which improved student performance would be expected to maintain or stabilize after intervention removal; this would be an indication of long-term effects of the intervention (Hersen & Barlow, 1977; Kazdin, 1982).

Instruction. A model-lead-test instructional paradigm was used to shape learner response to an independent level of performance. Following baseline conditions, the teacher *modeled* use of the critical thinking map, then *lead* the student in completing the map, and finally required the student to complete the map independently (*test*). These procedures are described in more detail as follows. For phase changes from test to lead to maintenance phases, criterial levels of mastery were set to determine when to make a shift in phases.

Baseline conditions (A). During baseline conditions, daily percent of correct comprehension (primary dependent measure) was monitored and continued throughout all phases as a means of comparing phases. On the first day of baseline, the teacher explained the meaning of the questions to be asked after reading. These questions (see Figure 2) were the same as the component parts of the critical thinking map. The teacher explanations were based on the definitions for each map component which appear in an earlier section. (Teachers verbalized this information to the principal investigator prior to explaining it to the students.) On the first day and subsequent days students were shown the parts of the social studies lessons to be read and asked to determine how many pages were to be read. They were reminded that they would answer written questions about what they had read when they were finished reading the assignment silently. Time spent reading silently was recorded by the teacher. Students then answered the five questions being told to construct the best possible answers without referring back to the lesson. Upon completion, a 100-word timed sample of the students' oral reading, randomly selected from the lesson, was collected as a means of monitoring accuracy and rate of reading.

[Insert Figure 2 about here.]

Intervention conditions (B). During this phase the teacher *modeled* the responses she desired when using the critical thinking map (see Figure 1). The teacher orally noted the number of pages to be read and then read the lesson aloud, talking about map components as she identified answers to them in the lesson, and filling in this information on the map. After completion of reading, she orally read the map components, checking for response accuracy and adding more information when necessary. Then the student silently read the questions and wrote written responses to the questions, as described for baseline conditions. Finally, the timed sample was collected. This modeling phase was continued for at least three days unless performance was at or above a criterion of 80% correct responses to the generic questions. An exception was subject C; this was the first subject to receive the treatment. Experimentation was allowed to determine if students would reach the 80% mastery criterion if the number of days in this phase were extended. After 10 days, subject C had not yet reached criterion but was gradually improving. As can be seen with all of the remaining students (Figures 3 & 4), extended length of the model phase was not important, as the students were only passively engaged, observing the teacher using the map. Rapid improvements were seen once the *lead* phase described below was begun with students being more actively engaged.

[Insert Figures 3 & 4 about here.]

During the *lead* phase, baseline conditions were followed with the student silently reading the lesson. The student and teacher then examined the lesson together, looking for answers to map components. The teacher encouraged student initiations, responding only if the student was unable to locate or infer a correct response. The student wrote all responses on the map. Baseline conditions were followed for responding to questions and obtaining the timed sample. Task mastery was defined by setting a criterion level of 75% correct responses to comprehension questions for two out of three consecutive days.

In the *test* phase, students were told to read silently and then to construct the map without teacher assistance. If the student did, in fact, request teacher assistance, the teacher provided help by reverting to the conditions followed during the *lead* phase. An exception to this error correction procedure was that teachers never provided assistance for these map components: Other Viewpoints, Reader's Conclusions, and Relevancy. After lesson reading and map completion, students wrote written responses to the comprehension questions. Note that students B and E never received the *test* phase; by the time they had completed the *lead* phase, there was insufficient time to implement the *test* phase, and these students were moved to the *maintenance* phase. The mastery criteria necessary to change phases was a 75% correct response to the comprehension questions for five of six days.

Maintenance conditions. Immediately following the *test* phase, baseline conditions were followed as a means of demonstrating a maintained improvement over time. Essentially, students read lessons and answered the questions without using the critical thinking map.

Materials

The lessons that formed the base for the intervention were taken from a social studies text written about American history (Fenton, 1975). The passages were used in the order in which they appeared in the text because they followed a logical and temporal sequence.

Dependent Measures

Five types of dependent measures were monitored in this study. The first was percentage of correct responses to five generic questions (see Figure 2). These questions were asked after completion of each social studies lesson.

The second and third types of dependent measures were attempts to measure generalization of improved reading comprehension. One was a measure of *near generalization* for which students read lessons from a different social studies series containing similar passage constructions (Rekosh, 1981). The second was a measure of *far generalization* for which students read lessons from a very different type of content area. The text was required in a driver's education class taken by nearly all students in the students' high school (American Automobile Association, 1970).

Both generalization tests were administered before beginning baseline conditions (pretest) and after finishing the maintenance phase (post-test). Six sample lessons were randomly selected from each of the two texts (social studies and driver's education). Three lessons were used for pretests and three for post-tests. The same generic questions (Figure 2) were used for these generalization tests. Measures of accuracy and speed of oral reading of a time, 100-word sample of each lesson were also obtained. The latter measures were taken to ensure that the students could read the words in the lesson (90% or better) well enough to validate collection of a measure of reading comprehension.

The fourth type of dependent measure was performance on several standardized reading tests. The tests included the vocabulary and comprehension subtests of both the Nelson Reading Skills Test (Hanna, Schell, & Schreiner, 1977) and the Stanford Achievement Test (Gardner, Rudman, Karlsen, & Merwin, 1983). A measure of reading rate was also collected from the Nelson Reading Skills Test.

The fifth type of dependent measure was a series of subtests from one of two standardized tests of reading and intelligence. These subtests were selected because they were thought to be possible measures of generalization of nonverbal and verbal thinking abilities. The nonverbal ability measures were the *Analysis/Synthesis* and *Concept Formation* subtests of the Woodcock-Johnson Psycho-Educational Battery. The verbal ability measures were the *Analogies* subtest of the Woodcock Reading Mastery Test and the *Similarities* subtest of the Weschler Intelligence Scales for Children--revised.

The final set of dependent measures was two questions designed to record the students' own strategies for understanding and remembering what they had read. For a test of understanding students were asked, "What do you do to help yourself understand what you read?" The question for testing remembering was, "How do you help yourself remember what you read?" Both questions were asked of all students *before* the baseline phase began and *after* the maintenance ended.

Reliability Procedures and Results

All instructional procedures were practiced in simulation by the teachers prior to teaching the students. These simulations were observed by the principal investigator until teaching procedures were mastered. Then, teachers followed a checklist to make certain they observed the instructional procedures in a precise sequence. Teachers occasionally observed each other while teaching to ensure that these procedures remained constant.

All standardized tests and subtests were scored independently by two persons, with 100% inter-rater agreement.

The responses to the generic questions used in daily instruction and for both near- and far-generalization measures were scored in their entirety by each of two independent scorers. Responses resulting in discrepant results were scored a third time by the principal investigator. This person also independently scored 20% of all responses obtained from daily instruction and all measures of far- and near-generalization. The scoring criteria appear in Figure 5. Inter-rater reliability coefficients between the first two raters (Pearson *r*) were calculated from a total of 232 responses. Agreement was high and always statistically significant ($p = .001$) across all five question types: important events, points or steps ($r = .93$), main idea/lesson ($r = .98$), other viewpoints/opinions ($r = .98$), reader's conclusions ($r = .91$), relevance to today ($r = .91$).

[Insert Figure 5 about here.]

Results

Generic Questions

All six students showed positive shifts in their ability to respond to the generic questions, asked after reading each lesson. The two special education students were more likely to show a drop in maintained behavior when the critical thinking map was removed. These students both showed significant improvement in reading comprehension; however, student B had the most difficult time learning to use this strategy (Figure 1). At the end of the study she was just beginning to complete the maps without teacher assistance (*lead phase*). As expected, the improvements were more likely to regress during the maintenance phase. In contrast, Student A completed the test phase of independence; her performance regressed in the first day of maintenance but steadily improved back to the mastery level.

The special education students required more days of instruction (39 and 40 days for students A and B) than the remedial reading students who ranged from 27 to 33 days of instruction. These days included model, lead and test phases.

The most impressive improvements were seen in the remedial students; all four were characterized by strong and positive shifts in comprehension from baseline to test phases (Figure 3). They maintained this improvement in reading comprehension when no longer required to use the critical thinking maps. Even Subject E, who was not in the study long enough to reach the test phase, demonstrated maintained improvement. It is interesting to note that both subjects D and F completed both the lead and test phases in a very brief amount of time (6 to 10 days), but performance during the first maintenance phases began to dissipate. Both students were returned to test phase, using the maps independently. After a longer period of time (9 to 10 days for test phase alone), their comprehension showed maintained behaviors well above criterion mastery.

Near- and Far-Generalization

All six subjects showed improvement in reading comprehension on the measure of near-generalization, ranging from 11% to 60% improvement (Table 2, column 16). The smallest improvement was shown by Subject E and the greatest by Subject F, both remedial reading students. Four of the six subjects improved on the far-generalization measure of comprehension, reading in the driver's education materials. One special education student (Subject B) and one of the remedial reading students (Subject D) failed to improve on this measure.

For both daily reading and the measures of near- and far-generalization, all subjects continued to correctly recognize 90% or more of the words during oral reading. The rates at which they read varied considerably across subjects, as was reflected by the pre-/post-median scores for correct words per minute (cwpm) for both near- and far-generalization tests (refer to columns 15 and 18 of Table 2).

[Insert Table 2 about here.]

Standardized Tests of Reading

Grade equivalent gain scores on the vocabulary and comprehension subtests of both the Nelson Reading Skills Test and the Stanford Achievement Test indicated improvement in four of the six subjects. (Improved gain scores are those in Table 2 that are enclosed in boxes.) Scores were considered to be an improvement when the gain was larger than the number of months the student received instruction (see the final column in Table 2 for these durations of time). All subjects made a gain in vocabulary on at least one of the two vocabulary tests, although the gains of Subject C did not meet the criterion for time duration. Five of the six subjects improved on one of the two tests of comprehension. Again, Subject C failed to improve on either test. Subject C was not one of the slower students and, in fact, showed improved and maintained gains in daily instruction. Five of the six subjects, excluding Subject E, showed large gains in reading speed on the Nelson Reading Skills test.

Generalization of Thinking Abilities

Four of the six subjects gained in grade equivalent scores on at least one of the two subtests for nonverbal thinking (Table 2, Columns 10 & 11). Subjects E and F, both remedial reading students, did not improve in this area. All subjects improved on one of the two verbal subtests (Table 2, Columns 12 & 13), with the majority (n=4) doing so on drawing analogies.

Students' Individual Strategies

The majority of these students showed increased use of the types of strategies they used spontaneously to encourage remembering and understanding. Improved quality of responses was defined as any indication that the student was aware of the need to think about the reading, and/or to ask oneself questions about the reading. The individual responses are displayed in Table 3, organized by pre- and post-responses to each of the two questions. Four students improved the quality of their response in describing a comprehension (understanding) strategy (Students A, D, E, & F). Two students (B and C) showed good responses during the pretest. For memory (remembering) strategies, four of the six students showed improved responses (Students A, B, E, & F). Again, student B showed good initial responses.

[Insert Table 3 about here.]

For both response types there is considerable variety in the types of strategies students selected. Comprehension strategies ranged from improved attention to text, reading slower, skimming for main ideas and remembering to think about what was read. The memory strategies were also varied, including self-questioning, inferring meaning of unfamiliar words, remembering to think about the lesson, and slowing down the reading process. An interesting phenomenon is that the one student who consistently offered good pretest strategies was one of the poor comprehenders in the group, raising questions about whether she was actually applying the strategies she described, especially at the beginning of the study.

Discussion

Educators concerned with teaching very poor readers to read have been much more likely to focus on teaching word recognition, and much less likely to place emphasis on teaching students to think as they read. It's almost as if teachers have believed that, once the physical act of decoding has occurred, the encoding process (processing of received information) will occur naturally. The findings of this study lend support to the position that reading comprehension can be greatly improved by teaching students to impose a structure upon the text, especially if the structure provides a basic framework for readers' thinking processes as they read.

In this study there was some indication that improvement will occur more quickly and last longer with remedial reading students than with special education students, although all students showed improvement on daily comprehension when using the critical thinking map. These differences may be due to differences in intellectual ability, although a more indepth exploration of differential performance is needed. Researchers interested in studying the relationship between thinking and reading comprehension need to identify the particular aspects of intelligence that promote good understanding.

There was also a tendency for the less able students to be more dependent upon teacher assistance, as shown by the longer practice period needed to reach a level of independent learning. Similar findings emerged in an earlier study (Idol-Maestas, 1985), in which students classified as being learning-disabled and demonstrating poor comprehension showed good comprehension improvement with teacher assistance, but decreased comprehension without the teacher. Although the methods were different in the first study, which focused more on teaching prereading activities, the same general pattern was observed in the present study. In contrast, in another study (Idol & Croll, in press), improved comprehension maintained without teacher assistance with a younger group of learning-disabled students. The methods were more similar to those used in the present study, in that a type of mapping strategy was used to teach students about the general structure of narrative stories. A difference was that the two studies showing a dependency on teacher assistance for slower students also required the students to rely more upon their own thoughts, while the contrasting study required them only to search for text information (explicit and implicit). It may be that the more the task requires independent thinking, the more the slower learner will falter; this observation may form a base for development of a distinction between intellectual differences of remedial reading students and those of special education students.

However, in spite of possible differences in intellectual ability, all of the students showed some ability to generalize the improved comprehension to reading of unfamiliar and different passages. All students showed this generalizability of response when reading in a different social studies series; the degree of improvement ranged greatly (11% to 60%) with no consistent pattern to differentiate special education from remedial reading students. Four of the six students also improved their understanding of a different type of content area reading (a driver's education text); again with no distinction between the two classes of students. It is likely that student gains may have been influenced by their high level of motivation to understand the driver's education text.

On the more global measures of generalization (verbal and nonverbal subtests of standardized tests), all students improved on at least one of two verbal tests and four of the six students improved on one of two nonverbal tests. Most also showed refinement and improvement of personal responses to strategies they used for thinking and remembering. On standardized reading tests, all students showed gains in vocabulary and all but one gained in comprehension.

Ability to generalize and transfer learning across situations is certainly a type of intelligence importantly related to reading ability. These findings would seem to indicate that although slower students are more likely to depend on teacher assistance, both slower and more able students can be expected to transfer some learning to new situations. Future research in this area must be conducted to examine more closely, possible intellectual differences across classes of readers with larger samples of subjects. For instance, are there some dimensions of intelligence, such as independence in thinking and activating schemata, that are poorer in slower students and likely to exclude them from reading with the rich understanding that schema theorists expect should occur in good readers? To date, our findings suggest that given direct and carefully shaped instruction, comprehension can be improved and transfer can be expected. The relationship between certain facets of intelligence and certain comprehension strategies may be the reason for the success of some strategies over others. Apparently the critical thinking map was helpful in leading students through a series of steps resulting in the formulation of a set of logical conclusions. Conclusions were based upon a merger of new text information with prior knowledge, mediated by the reader's own ability to synthesize, and resulted in a final conclusion applied to contemporary situations. The next step in this line of research is to examine ways to improve the independent thinking that occurs during synthesis in slower students, as a means of reducing teaching dependence.

Application of Research to Practice

For teachers interested in teaching their students to use critical thinking maps, the following steps may be followed:

Step 1: Have the student read several lessons silently, checking comprehension of each lesson by requiring the student to answer the five generic questions in Figure 2, after reading the lesson. Take a 100-word timed sample of the student's oral reading from each lesson to make certain the reading level of the lesson is not too difficult. (This oral reading sampling can be done periodically throughout Steps 3 to 10.)

Step 2: Make a decision based on the comprehension data obtained in Step 1 as to whether or not the student needs to learn to use a critical thinking map. (Continue to have the student plot comprehension data throughout all of the subsequent steps *if* the decision is to teach map usage.)

Step 3: Show the critical thinking map to the student and explain what is meant by each of the map components. (Refer to an earlier section of this article for definitions of each component.)

Step 4: For two lessons show (*model*) the student how to use the critical thinking map by (a) orally noting the number of pages to be read in the lesson, (b) reading the lesson aloud interrupting yourself as answers to map components are encountered in the text, (c) filling in map components as answers are encountered, and (d) after the lesson is completely read, orally re-reading the contents of the map components, checking for accuracy and adding more necessary information.

Step 5: Instruct the student to read a lesson silently. Then, with the student, re-examine (*lead*) the lesson looking for answers to map components (Steps 4b and 4c above). Then, have the student complete Step 4d, above, offering assistance when needed.

Step 6: Instruct the student to give you the completed critical thinking map. Then, give the student the generic questions (Figure 2) to answer with written responses, to then be turned in to you for correction.

Step 7: Return the teacher-corrected critical thinking map and responses to generic comprehension questions. Discuss with the student any discrepancies between incorrect comprehension responses and correct map information. Have the student rewrite incorrect comprehension responses.

Step 8: Gradually require the student to fill in the map components with less assistance from you (*test*).

Step 9: When comprehension responses consistently remain above 80% correct with little or no assistance from you, discontinue use of the critical thinking map, having the student continue as described in Step 1.

Step 10: Offer the student a new challenge by discontinuing use of generic questions; instead, require the student to silently read the passage and write a paragraph which pertains to each of the components of the critical thinking map.

Of course, the above sequence of instruction can be modified for group instruction by completing Steps 3 to 5 with the group at large, requiring the students to read silently and demonstrating and asking questions of the group at large. Refer to Idol (in press) for an example of how instruction of a similar mapping strategy was adapted for group instruction.

References

American Automobile Association (1970). *Sportsmanlike driving* (6th ed.). St. Louis: Webster Division, McGraw-Hill Book Company.

Anderson, R. C. (1977). *Schema-directed processes in language comprehension* (Tech. Rep. No. 50). Urbana: University of Illinois, Center for the Study of Reading (ERIC Document Reproduction Service No. ED 142 977).

Anderson, R. C. (1978). Schema-directed processes in language comprehension. In A. Lesgold, J. Pelligreno, S. Fokkema, & R. Glaser (Eds.), *Cognitive psychology and instruction* (pp. 67-82). New York: Plenum.

Anderson, R. C., Spiro, R. J., & Anderson, M. C. (1978). Schemata as scaffolding for the representation of information in connected discourse. *American Educational Research Journal, 15*, 433-440.

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91-97.

Baker, L., & Brown, A. L. (1984). Metacognitive skills and reading. In P. D. Pearson (Ed.), *Handbook of reading research*. New York: Longman.

Brown, A. L., & Palincsar, A. S. (in press). Reciprocal teaching of strategies: A national history of one program for enhancing learning. In J. Borkowski & J. D. Day (Eds.), *Intelligence and cognition in special children: Comparative studies of giftedness, mental retardation, and learning disabilities*. New York: Ablex.

Collins, A., & Smith, E. (1982). Teaching the process of reading comprehension. In D. K. Detterman & R. J. Sternberg (Eds.), *How and how much can intelligence be increased*? Norwood, NJ: Ablex.

Eller, W. (1967). Reading and semantics. In M. L. King, B. D. Ellinger, & W. Wolf (Eds.), *Critical reading*. Philadelphia: Lippincott.

Englemann, S., & Carnine, D. (1982). *Theory of instruction: Principles and applications*. New York: Irvington Publishers, Inc.

Fenton, E. (1975). *The Americans: A history of the United States*. Carnegie-Mellon Social Studies Curriculum. New York: Holt, Rinehart & Winston.

Flavell, J. H. (1981). Cognitive monitoring. In W. P. Dickson (Ed.), *Children's oral communication skills*. New York: Academic Press.

Gardner, E. F., Rudman, H. C., Karlsen, B., & Merwin, J. C. (1983). *Stanford Achievement Test*. New York: The Psychological Corporation, Harcourt Brace Jovanovich.

Hanna, G., Schell, L. M., & Schreiner, R. (1977). *The Nelson Reading Skills Test*. Iowa City: Houghton Mifflin.

Hersen, M., & Barlow, D. H. (1977). *Single case experimental designs*. New York: Pergamon Press.

Idol, L. (in press). Group story mapping: A comprehension strategy for both skilled and unskilled readers. *Journal of Learning Disabilities*.

Idol, L., & Croll, V. J. (in press). The effects of training in story mapping procedures on the reading comprehension of poor readers. *Learning Disability Quarterly*.

Idol-Maestas, L. (1985). Getting ready to read: Guided probing for poor comprehenders. *Learning Disability Quarterly, 8*, 243-254.

Kazdin, A. E. (1982). *Single-case research designs*. New York: Oxford University Press.

Palincsar, A. S., & Brown, A. L. (1984). Reciprocal teaching of comprehension-fostering and comprehension-monitoring activities. *Cognition and Instruction, 1*(2), 117-175.

Pearson, P. D., & Johnson, D. D. (1978). *Teaching reading comprehension*. New York: Holt, Rinehart & Winston.

Rekosh, L. (1981). *Power skills in social studies - I*. New York: McGraw-Hill Book Company.

Rumelhart, D. E. (1981). *Understanding understanding* (Tech. Rep.). San Diego: California University, Center for Human Information Processing. (ERIC Document Reproduction Service No. ED 180 888).

Spiro, R. (1980). Constructive processes in prose comprehension. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), *Theoretical issues in reading comprehension*. Hillsdale, NJ: Erlbaum.

Spiro, R. J., Bruce, B. C., & Brewer, W. F. (Eds.) (1980). *Theoretical issues in reading comprehension*. Hillsdale, NJ: Erlbaum.

Vacca, R. T., & Vacca, J. L. (1983). Re-examining research in reading comprehension in the content areas. In B. A. Hutson (Ed.), *Advances in Reading/Language Research, Vol. 2*. Greenwich, CT: JAI Press.

Wechsler, D. (1974). *Wechsler Intelligence Scale for Children--Revised*. New York: The Psychological Corporation.

Woodcock, R., & Johnson, M. (1977). *Woodcock-Johnson Psycho-Educational Battery*. Circle Pines, MN: American Guidance Service.

Table 1

Summary of Descriptive Data for the Six Subjects

Subject	Age	Grade	Program	Race	Entry level/SDRT[a] Vocabulary	Comprehension	Difference Score[b]
A	16	11	Special Education	Black	no score available	3.0	8.0
B	16	11	Special Education	White	3.8	4.6	6.4
C	16	11	Remedial Reading	Black	7.1	7.7	3.3
D	15	10	Remedial Reading	White	9.1	8.8	1.2
E	16	11	Remedial Reading	White	7.9	7.6	3.4
F	16	10	Remedial Reading	White	6.7	7.2	7.8

[a]Scores reflect grade equivalents.

[b]Scores reflect differences in years-months between students' grade level at the beginning of the study and the reading comprehension score on the SDRT.

Table 2

Summary of Secondary Dependent Measures Across Subjects

		Entry Level/SDRT		Standardized Tests of Reading					Standardized Tests of Generalization			
Subject	Grade	Vocab[a]	Comp	NRST (Vocab)	NRST (Comp)	NRST (Rate)	SAT (Vocab)	SAT (Comp)	Woodcock (Anal/Syn)	Woodcock (Concept Form)	Woodcock[b] (Analogies)	WISC-R (Similar)
A (IQ 59)	11		3.0	+0.2	-0.8	+2.6	+0.6	+1.0	+2.3	+3.8	+1.0	-5 pre post
B (IQ 72)	11	3.8	4.6	+4.8	+1.1	+3.6	+0.3	+1.0	0.0	+0.8	-1.0	+2
C	11	7.1	7.7	+0.2	-0.7	+5.7	+0.4	-.04	0.0	+5.5	+2.0	0
D	10	9.1	8.8	+0.4	+0.7	+1.3	0	+1.0	+1.0	+1.0	+3.4	0
E	11	7.9	7.6	-0.3	0.0	-0.4	-0.4	+0.7	-3.0	0.0	+0.5	-2
F	10	6.7	7.2	+2.5	+4.3	+5.0	+2.2	-.06	0.0	0.0	0.0	+4

Table 2 (Continued)

Near Generalization[c]			Far-Generalization			Time Duration
Accuracy	Rate	Comp	Accuracy	Rate	Comp	
Pre 94%	62 cwpm	13%	97%	108 cwpm	8%	4.5 mo.
Post 97%	87 cwpm	50%	97%	101 cwpm	30%	
90%	57 cwpm	13%	96%	101 cwpm	46%	5.0 mo.
95%	64 cwpm	40%	96%	96 cwpm	15%	
98%	55 cwpm	13%	99%	68 cwpm	33%	5.0 mo.
97%	75 cwpm	45%	99%	91 cwpm	55%	
98%	116 cwpm	4%	100%	173 cwpm	63%	3.0 mo.
96%	94 cwpm	30%	100%	159 cwpm	50%	
97%	79 cwpm	4%	97%	99 cwpm	17%	4.0 mo.
93%	91 cwpm	15%	95%	106 cwpm	60%	
90%	55 cwpm	25%	94%	105 cwpm	46%	3.0 mo.
96%	50 cwpm	85%	97%	93 cwpm	80%	

[a]Data reflect changes in grade equivalent scores (years, months) for columns 3 to 12.

[b]Data reflect raw score changes for column 13.

[c]Data reflect median, pre-/post scores for columns 14 to 19.

☐ = Grade equivalent gain scores greater than time duration of study.

Table 3

Pre- and Post-Responses to Questions about Understanding and Recalling Strategies Used by Subjects

Subjects	Understanding		Remembering	
	Pre-Responses	Post-Responses*	Pre-Responses	Post-Responses
A	Ask questions; read it over.	Read it over as many times as possible and think about what I have read before I put anything down.	Skim through it.	I must remember what I read and I think over the question before I answer the question.
B	I reread it, figure out what questions people might ask, like who's the main character, what the plot of the story is.	Re-read to help me understand; what I read; read something that I can understand.	Reread it, ask myself what was the story about, parts of the story.	I would re-read a book, then someone would ask me what happened, who is the main character, what happened in the story that is so important.
C	Stop and read it again. Read slow. Remember what I read.	Read it again.	Think about the first sentence or what the story is about.	Pick out some word I don't know, and it sticks in my head because I didn't know what it meant. Read it again.
D	Reread paragraph--what's been said before might help me understand better. Ask teacher for help.	Read it more slowly and put my mind to it and pay attention to what it says. Go over it more than once.	Reread until I know. Depends on how interesting it is, whether I can keep it in my head.	Go over it more than once. Read slowly. Get more sleep the night before.
E	Read between the lines to figure out what I'm reading.	I go over it again. Read slower.	I try to remember important parts about the story.	Think over what I just read, what happened.
F	Say to myself that I don't care if people don't like the way I read. So then I get confidence and I can do it. I stop, try to sound out in syllables. Then if that doesn't work, I ask the teacher.	Read it over again real quick, skim over it. Try to look for the main words in the passage. You can tell what they are.	Read it slower, or skim through it again.	Read it slower instead of real quick. Ask myself questions about what I just read, right after the sentence is done.

*Improvements are underlined in the post-responses.

Figure Captions

Figure 1 A map for critical thinking.

Figure 2 Generic questions asked for each social studies lesson.

Figure 3 Percent of correct responses to generic comprehension questions across phases with multiple baselines for two special education students.

Figure 4 Percent of correct responses to generic comprehension questions across phases with multiple baselines for four remedial reading students.

Figure 5 Scoring criteria for generic comprehension questions.

Name_____ Chap. _____ Part _____

Date_____ Phase _____

A Map for Critical Thinking

Important Events, Points, or Steps

Main Idea/Lesson

Other Viewpoints/Opinions

Reader's Conclusion

Relevance to Today

Figure 1

Generic Comprehension Questions

Chapter _____ Phase _____

Lesson _____ Day _____

Page _____

1. What is the main idea in this passage?

2. What were the important steps that led to the main idea?

3. What are some other points of view or missing information about this topic?

4. What is your own conclusion?

5. How is this passage relevant to a modern problem or issue?

Figure 2

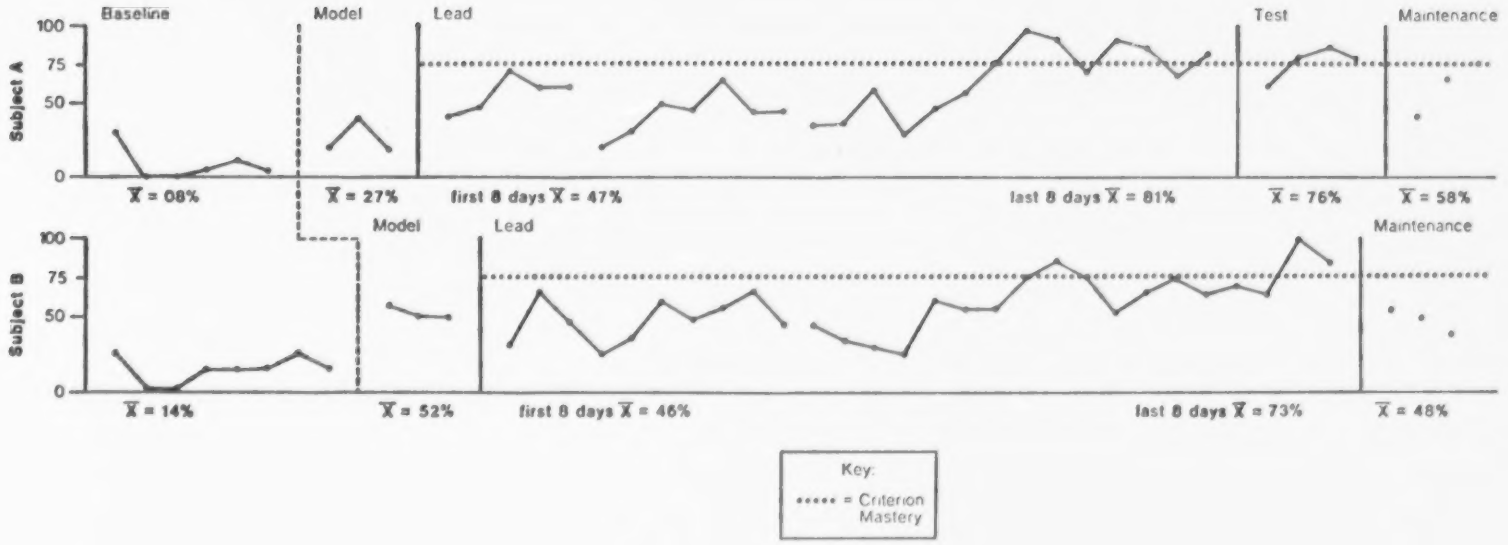
Baseline
Model
Lead
Test
Maintenance
Subject A
100
75
50
0
X̄ = 08%
X̄ = 27%
first 8 days X̄ = 47%
last 8 days X̄ = 81%
X̄ = 76%
X̄ = 58%
Model
Lead
Maintenance
Subject B
100
75
50
0
X̄ = 14%
X̄ = 52%
first 8 days X̄ = 46%
last 8 days X̄ = 73%
X̄ = 48%
Key:
••••• = Criterion Mastery

Figure 3

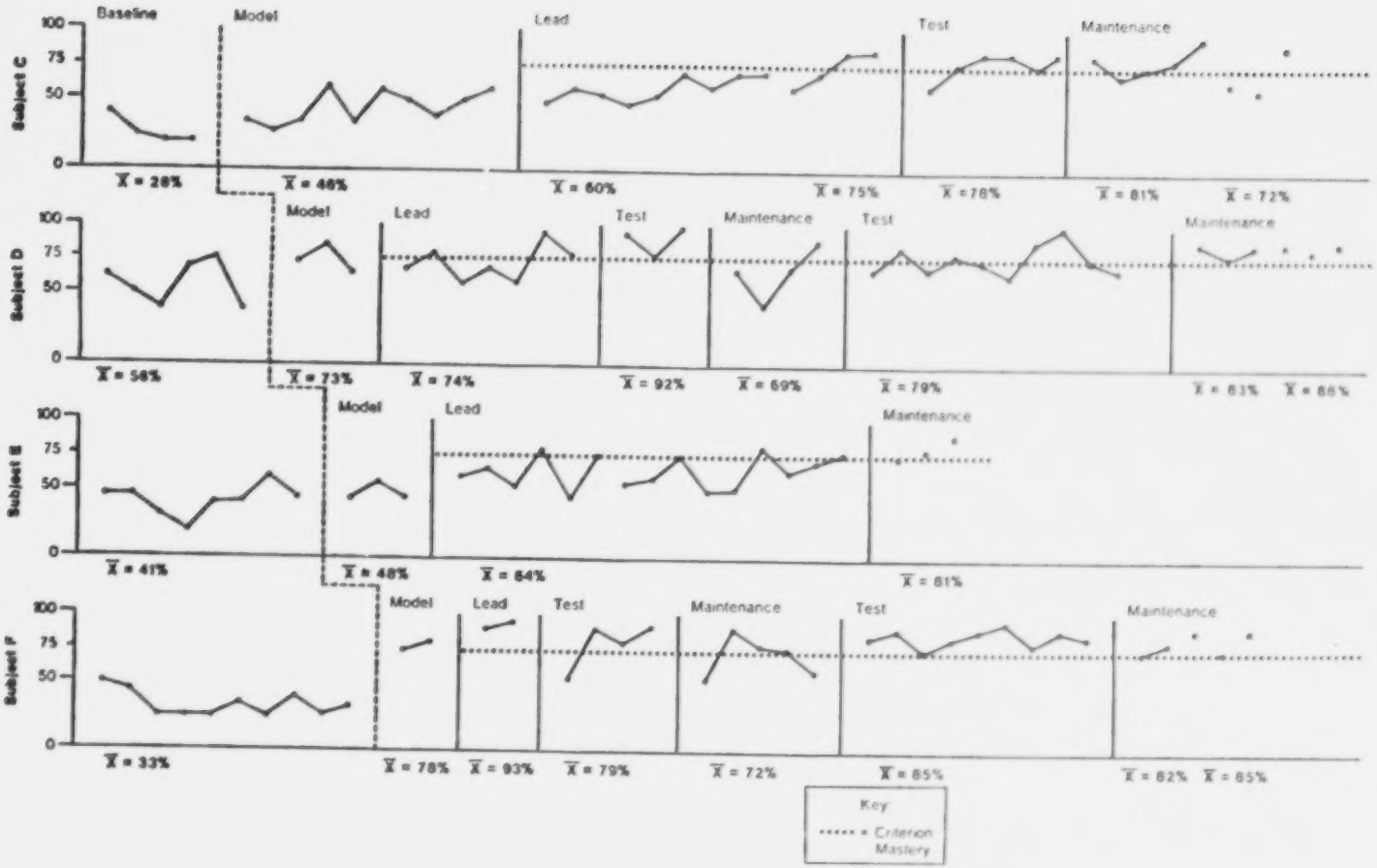
Subject C
Baseline
Model
Lead
Test
Maintenance
X = 28%
X = 46%
X = 60%
X = 75%
X = 78%
X = 81%
X = 72%
Subject D
Model
Lead
Test
Maintenance
Test
Maintenance
X = 58%
X = 73%
X = 74%
X = 92%
X = 69%
X = 79%
X = 83%
X = 88%
Subject E
Model
Lead
Maintenance
X = 41%
X = 48%
X = 64%
X = 81%
Subject F
Model
Lead
Test
Maintenance
Test
Maintenance
X = 33%
X = 78%
X = 93%
X = 79%
X = 72%
X = 85%
X = 82%
X = 85%
100
75
50
0
Key
----- = Criterion Mastery

Figure 4

Scoring Criteria for Generic Comprehension Questions

Give a total of 20 possible points, four points possible for each of the following:

1. Important Events (Answers stated explicitly in the text.)

   Points

   0 = no response or completely wrong
   1 = 1 point, step or event was identified
   2 = 2 points, steps, etc.
   3 = 3 or 4 points
   4 = 5 or more points, etc.

2. Main Idea/Lesson (Answer stated both explicitly and implicitly in the text.)

   Points

   0 = no response or completely wrong
   1 = 25% of a correct answer
   2 = 50% of a correct answer
   3 = 75% of a correct answer
   4 = excellent answer demonstrating full understanding of a passage or lesson

3. Other Viewpoints/Opinions (Answers are scriptally implicit and based on reader's background knowledge.)

   Points

   0 = no response or completely wrong
   1 = no point made but it is inaccurate
   2 = one point made (accurate)
   3 = two points made (accurate)
   4 = three or more points made (accurate)

4. Reader's Conclusions (Answers based on reader's ability to retrieve and integrate information.)

   Points

   0 = no response or completely wrong
   1 = bases conclusions only on own point of view
   2 = bases conclusions only on author's main purpose
   3 = bases conclusions on own viewpoint & author's purposes
   OR
   3 = conclusions based on own point of view plus a new synthesized thought
   OR
   3 = conclusions based on author's purpose plus a new synthesized thought
   4 = bases conclusions on own viewpoint and author's purpose coupled with a new synthesized thought

Figure 5

5. Relevance to Today (Answers based on reader's ability to retrieve, integrate and apply information.)

Points

0 = no response or completely wrong
1 = generally relevant to topic but not really the major lesson or intent of the reading
2 = the major intent of the piece is conveyed but the student doesn't add anything new
3 = the major intent is conveyed coupled with a new synthesized thought
4 = all of the above (no. 3) are met coupled with excellent quality of expression

Figure 5 (Continued)